

solplan review

the independent journal of energy conservation, building science & construction practice

Inside . . .

Codes and regulations are something we can't avoid. We review a study that looked at the impact codes have on innovation and changes in building technology. We also discuss an example of where the system hiccuped and didn't work the way it should.

Airtightness of structures is important for the durability of the structure as well as comfort and energy considerations. But basements haven't been looked at too much. A study pointed out that wood foundations may be much leakier at points that can be sealed if done properly, than was expected.

Combustion equipment in the house must be used properly to avoid health and safety problems. Skip Hayden discussed the key issues.

Housing accessibility for the disabled of all ages is becoming a major issue. To help show how it can be done, CMHC has put together a demonstration that could be coming to a city near you. Take a look at it.

Other items include reader correspondence, updates on the Advanced Houses Program initiated by EMR/CANMET, and more.

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Codes and Regulations



From the Publisher . . .

We all have to deal with a wide range of rules and regulations. Like death and taxes it's something we can't get away from in our increasingly complex and sophisticated society. (I can hear the old timers mumbling about the good old days when you didn't have to deal with regulations and codes thick enough they'd fill a semi-trailer!)

Like it or not, even in those old days there were rules, guidelines or whatever. Perhaps not as complex as today, but they've always been with us. Even when the first cavemen started building structures (by trial and error), as soon as they figured out the proper way to do it, the knowledge was passed on to following generations by means of taboos, legends, rules of thumb, guidelines, or whatever - but they all are essentially the same thing as today's codes.

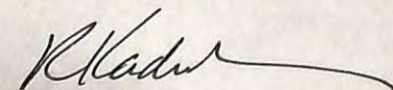
Codes and standards are mechanisms we've created to set out minimum safety or performance standards. Where the minimum lies, how complex or easy follow they are, how far they go or how they are administered is often a matter of debate.

I raise this topic as this issue we feature a couple of items about code and regulatory issues. While no one likes to be told what they can or can't do, when living in a community there are going to have to be some common rules to avoid abuse by some. The topic becomes one of how far the rules and regulations should go, and more importantly, how the rules are developed. When they are drawn up they should be reasonable and technically correct.

This is why it often takes such a long time for a change to be made when changes are needed. In the case of a new standard, it is even more difficult as rules should not be so tightly written that they make it difficult to introduce changes or new technology.

At the same time, the process for ruling on interpretations of what is acceptable or making changes must be fair, not arbitrary. An example of the later case has seen in B.C. recently, where a special interest group was able to create havoc, almost putting a supplier out of business, by challenging new technology that the regulatory agency was incapable of dealing with in a fair and impartial manner, not able to assess the subject on its technical merits only (or did not want to, swayed by the special interest group).

This is the type of action that gains regulators a bad image and reinforces the image of the regulator as an obstacle to changes or improvements in technology.



Richard Kadulski
Publisher

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Illustrations: Terry Lyster
Contributors: Jeff Rockburn, Skip Hayden, Ross Monsour, George Pinch
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Richard Kadulski Architect

#208 - 1280 Seymour St.
Vancouver, B.C. V6B 3N9
Tel: (604) 689-1841
Fax: (604) 689-1841

Innovation and Building Codes

It may sound strange to talk about innovation and codes in the same phrase. It's almost a contradiction in terms. Or at least that is the impression we usually have. But do building codes and other regulations actually create roadblocks to innovations in the construction process? To get an answer to this question, a study was done by A.T. Hansen Consulting Services and Scanada Consultants for CMHC.

The effect of the building regulatory process on innovation was examined from three points of view: the way codes are written, how they are administered, and the methods by which new products or systems are evaluated.

It has been suggested that the National Building Code (NBC) is too prescriptive, making innovation difficult. If regulations were more performance oriented, would innovation be easier to implement and building construction become more productive?

What is performance?

Some building regulations call for performance levels that can be verified and enforced (e.g. design loads, fire resistance, sound resistance). Others have requirements that are stated in performance terms that can't be verified easily (e.g. "adequate", "safe", "sufficient"). To deal with these, it may be necessary to have supplementary documents that list criteria that are "deemed-to-satisfy" the requirements.

Prescriptive requirements, on the other hand, provide a ready-made design solution. In most cases, building codes, including the NBC, are a mixture of both performance and prescriptive requirements.

The NBC increasingly relies on other referenced standards, so the nature of the Code is affected by the character of the standard. Although some have been written as performance requirements, most are prescriptive in nature.

The third major component affecting innovations, how the Code is administered, is influenced by the technical training

and attitude of local officials and the assistance available in day-to-day code enforcement. This can vary from jurisdiction to jurisdiction. In some provinces extensive services are available, including product evaluation, inspector training, code interpretation, workshops, seminars and newsletters. In others, practically no assistance is available and local officials operate on their own.

Are regulations too restrictive? No matter what kind of regulatory or approval system is used it will present some degree of restrictions to innovation. (If this were not the case, there would be no need to have any type of building regulations). So the question is how much is justified.

There is little evidence that the prescriptive requirements in the NBC by themselves seriously restrict innovations in

Code language from the
Norwegian building standards:

"The design and construction of lifts shall be adequate for the load and function of the lift. . . ,

Balconies, terraces, etc., shall have balustrades or other arrangements which prevent people from falling off."

construction.

When you encounter a restriction, there is a tendency to blame "the building code" regardless of the real cause for the limitation, whether it is due to the approval process, to the enabling provincial legisla-

tion or to the lack of experience of the administrator makes little difference to you.

Perhaps more importantly, the role played by local officials in making the system operate smoothly requires that building officials be adequately trained to encourage the judicious application of code regulations.

Some countries (as well as some provinces) are concerned about the cost of administering building regulations so they are exploring alternative arrangements, including privatization. This could also address the issue of inadequately trained building officials.

But what should be in codes and standards? There doesn't seem to be any consistent policy regarding the type of material to be included in the National Building Code or the material that should be in referenced standards.

What is the most important factor affecting innovations? The natural path for the introduction of innovations is by an evaluation process rather than by way of code recognition. Some innovators, however, are frustrated with the amount of

time needed for evaluation and with what they see as unnecessary demands for additional product testing.

The evaluation of alternatives or equivalencies can be assisted by clear statements that explain the objectives of individual NBC requirements.

We have had some experience with performance regulations in Canada, including non-verifiable requirements.

In 1965 Part 9 of the NBC was rewritten in general performance terms. The performance requirements specified that various aspects of houses and apartments be designed and constructed to conform to "good practice". Good practice in turn was deemed to be met if the construction conformed to the example prescriptive requirements in Residential Standards,

which described construction practices in considerable detail.

In effect, Part 9 was a check list to reference certain requirements in Residential Standards which contained the type of detail considered necessary for design and enforcement purposes. Part 9 was quickly ignored by code users as it was unenforceable and unenforceable. The next edition of the NBC (1970) put the detailed requirements into Part 9, and stopped its references to Residential Standards. Abandoning the performance approach was a direct result of complaints from code users.

Regulations in other countries

A survey of other countries found a wide range of approaches. Building regulations in Australia, New Zealand, Japan, USA, Britain, Norway and Sweden as well as the European Community were studied.

The U.S. model codes are generally similar in content to the NBC, being a mixture of performance and prescriptive requirements.

Regulations for England and Wales are expressed in non-verifiable performance terms. Deemed to satisfy solutions are issued as "approved documents" separately. The existing New Zealand Code is due to be replaced by a new code based on the approach taken in England and Wales. The Australian Code is similar in content to North American Codes.

Norwegian requirements, while mostly performance based are a mixture of the two. The performance requirements are both verifiable and non-verifiable, with the administering authority having considerable discretionary power.

The Swedish approach appears to decentralize the regulating process. The requirements are essentially performance based, with deemed-to-satisfy solutions made at the local level.

The Japanese requirements are more comprehensive than most, and cover zoning and building maintenance in addition to usual building code type requirements. The Japanese regulations are more pre-

scriptive than the NBC.

How are codes modified?

In the USA revisions to the model codes can be initiated by any concerned person while voting is restricted to code enforcement officials only.

The Canadian approach is designed to ensure that this does not happen and that no one group will dominate committee decisions. Although the U.S. model code process for initiating and reviewing proposed changes is open so that all are free to participate in discussions, there appears to be a fundamental weakness in the process whereby the policeman writes as well as enforces the law.

Increasingly, the NBC is used as a "directory" to the use of, and an instrument for giving legal status to standards.

The performance nature of the code is now very much a matter of the performance nature of its growing numbers of referenced standards.

The study suggested that there is little evidence to imply that current Canadian codes are unduly restricting innovations.

Innovation and Building Codes: A Study into Performance Codes prepared for CMHC by A.T. Hansen Consulting Services in association with Scanada Consultants.

Available from: Canadian Housing Information Centre, 700 Montreal Rd. Ottawa, Ont. K1A 0P7
Tel: 613-748-2367 FAX: 613-748-2402

Does Research Pay for Itself?

The Alberta Innovative Housing Grants Program has been active in research, development and technology transfer for over a decade. The Program's rationale has always been clear: housing research and development generates new ideas which improve housing and advance the industry; the housing industry under-invests in research and development for various legitimate reasons; the Program offsets this under-investment and yields intended qualitative and economic benefits.

Projects funded include not just technology and products but also design, services and information/education.

Last year Alberta was looking at cutting back on expenditures. Nothing was sacred, including the Innovative Grants Program. Fortunately, before taking action, an analysis of its impact was done.

The review found that as an investment the Program has more than paid for itself, and nearly all the innovations examined appear to be economic and technical successes. A sample of projects surveyed

showed the net benefit (a conservative estimate) to Alberta to be \$59.5 million, on an investment of less than \$10 million from 1978 to date. How many other government programs have this kind of rate of return?

Benefits are conservative as the study was limited to looking at the benefits that accrue directly to Alberta, but in most cases technology transfer extends beyond provincial borders, and most of the innovations are not yet fully commercialized.

The Program works closely with industry and does not pay the full cost of introducing most of the innovations funded. The applicant's investment almost always equals or exceeds the amount of the grants awarded. Many applicants would not have proceeded without the grants and the associated assistance.

The program's reputation also makes it a centre for housing innovation. It's an important factor that opened doors to export activity and enhanced the reputation of Alberta as a centre for housing information in Canada and internationally.

Codes and innovation: Part 2

or how not to do it; a case study of too much discretionary power by "authorities having jurisdiction".

Richard Kadulski

Changes in building technologies and systems are happening quickly. We see more systems that are not strictly covered by the regulations as they exist, but then the regulations don't say directly that they are not allowed. Recent developments in B.C. have pointed out the difficulty in dealing with new systems, how arbitrary some decisions can be, and how the rules can be manipulated against or in favour of a given technology.

So what's caused such a fuss? In a nutshell, a new way of providing space heating, using approved, standard equipment in a different way. The system combines the domestic water heater with space heating, so that the water heater provides both the space heating and domestic hot water. The wrinkle that has raised concerns is that potable water is used in the space heating piping circuit.

Integrated Heating Systems

What are they? Why are being used?

With the low energy demand of new energy efficient homes (and small town homes) there is a real problem getting equipment that is small enough. On the other hand, domestic hot water is used year round, and with a small space heating load, the domestic hot water heater may have more than enough capacity to provide both the space heat and water needs of the dwelling. Tying the domestic hot water system with the space heating makes a lot of sense. In fact, a few years ago CMHC commissioned a study to investigate the use of hot water tanks to heat homes in the Northwest Territories. The results indicated this was a satisfactory alternative system.

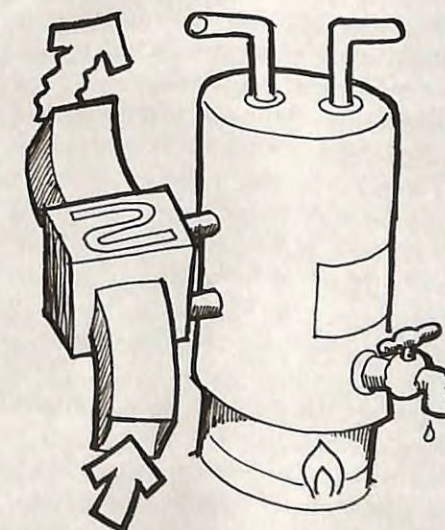
There are benefits for the home owner as only one boiler or heater is needed, so there is a lower capital cost and the heating equipment operates at a higher seasonal

efficiency (typically, optimum efficiency is gained when the heating element can run virtually continuously).

The simplest systems take water off the top of the tank, circulate it through a fan coil or radiant heating pipes, and return the water to the bottom of the tank.

Apollo Hydro Heat & Cooling is one manufacturer marketing a dual purpose water heating system; it uses an air handling fan coil that uses the water off the domestic water heater. Water is used directly, circulating potable water through a finned tube heat exchanger in an air handler or duct coil that provides warmed air, and returns the water to the bottom (cold part) of the hot water tank.

This type of system has now been installed in many thousands of houses across North America. It does not, however,



mean that it neatly fits into categories of codes and regulations. Individual components meet various standards, but when used as an integrated system there are no standards for a whole system.

Regulatory issues:

Concerns have been raised (by the Canadian Hydronics Council - the boiler manufacturers) about the standards (or lack of standards) that cover such integrated systems. They have brought up the fear of possible health safety problems through the potable water used in the circuit.

The concern is that potable water might get contaminated, especially during the non-heating season, when a stagnant loop of water may sit in the pipes. During this time, conditions might be suitable for bacterial growth and contamination of the water when it starts to flow again.

The fact of the matter is that there is no evidence of this happening in any of the many systems already in operation. Tests done in Ohio in 1982-84 (over two heating seasons) specifically looked for biological and chemical contamination but nothing was found. The water was "well within the acceptable range for potable water use. All important bacterial disease organisms that may be associated with water-borne diseases were tested and the data showed no evidence of these organisms."

The only source of bacteria is the main water supply, so if the water is safe, where is the bacterial contamination coming from? Most utilities recommend that domestic water be heated to 140 F (and in any case the Code requires it). At such temperatures, Legionella bacteria (a major concern) and other bacteria will not survive, although at lower temperatures (120-125 F) if there are any bacteria and the water is stagnant, then conditions could be

suitable for them to breed to dangerous concentrations.

With gas heating systems there is actually a higher margin of safety as during the heating cycle as the water may actually reach much higher temperatures for an instant during which it passes the flame.

What was not identified is what happens to the sunbirds and other travellers who go away for long trips (often for three or four months). They don't do anything special when they leave and presumably the water in the hot water tank sits in the hot water tank for the duration of the trip. I haven't heard of too many people draining the water tank on their return, yet everyone seems to be healthy. If bacterial growth were a real concern then we would see more problems with conventional systems (there's a lot more of them!).

Another concern brought up was that at 140 F the water is hot enough to scald a person (but it ignores the fact that the Code already calls for it).

The Code Administration problem

The B.C. Building Code is basically the National Building Code of Canada, as amended by the province, but the local building inspector has the power to make the final ruling on any issues relating to interpretation of the code.

If you have an alternative system or method that is not covered by the Code as written, the inspector has the power to accept or reject your case for the alternative. This means even if it is a technically correct system, he can reject it.

There is an appeal process, administered by the Province, that rules on appeals to local rulings of code interpretation. However, acceptance of equivalents that the code allows is a grey area. The Appeals Board rules on these issues, but in the final analysis it's still up to the local inspector. Usually, it's not a problem, as a ruling from the Provincial body will be accepted by most officials (but they don't have to).

Another problem is that the administrative bureaucracy in B.C. is very small and does not have the depth of staff required to sufficiently analyze issues in proper detail. While we don't want to see vast armies of bureaucrats, if they are going to write codes and make rulings on technical issues, then they must be done after proper evaluation. Proper engineering and scientific considerations have to be made.

To assist in the decision making process, there are advisory committees involving people from industry, but these bodies often are asked to rule on issues that most members may not be familiar with, without adequate background material, or without enough time to analyze the issue.

The dual purpose water heater systems issue sadly underlines this lack of technical expertise. When the issue was brought up (after a number of installations had been made), the fact that there was not enough sound documentation identifying the potential problems was not picked up. This type of system is potentially no worse than existing conditions when there is no water flow for prolonged periods of time. Instead, the onus to prove the safety of the system was placed on the supplier; the fact the system has a proven track record, and is used successfully in thousands of installations for many years was considered irrelevant. (Lawyers would call it "guilty until proven innocent").

When documentation was presented by the supplier as well as the electric and gas utilities, a draft regulation was prepared outlining under what conditions such a system would be accepted. The regulations underlined the lack of technical background or thought given to the proposed regulations.

For instance, they suggested this type of system could be used in dwellings with a floor area of up to 1900 square feet. What's magic about 1900 square feet? What about heat loss of the building? These are more important than the floor area.

Another point called for a minimum velocity of water flowing through the system, relative to the water temperature, but no explanation of why or how the numbers

established, rather than leaving the details to the designer of the system to determine what is needed for proper heat transfer.

In addition, a minimum and maximum water temperature range was proposed (in fact the code already calls for the minimum) and for a tempering valve to limit temperatures at plumbing fixtures (although this is not required in any other building).

An automatic pump circulation timer to circulate all water contained in the heating loop once every 24 hours was also proposed.

Postscript

As we went to press, we heard that the Building Code Appeals Board recommended approval of these systems (as an acceptable equivalent) provided they are fitted with a circulation pump on a timer to circulate water in the heating loop to avoid potential contamination of the potable water.

This decision could be considered as a precedent for all such installations in B.C., although there is no legal requirement for the inspector to accept it. However, any future rejections could be appealed and presumably the Appeals Board would again overturn the rejection.

The exception is the City of Vancouver, which due to a peculiar quirk of history, is not governed by the B.C. Building Code or the Building Standards Branch (the provincial Code agency), but it is to be hoped that as reasonable and rational people, they will pay attention to the Appeal Board.

Airtightness and Air Quality in Preserved Wood Foundations

A lot of work has been done to understand the air leakage characteristics of houses but the basement has not received much attention. Large air leakage in other parts of the building envelope (even though it contributes to higher energy consumption and deterioration of the structure) does not have major negative impacts on the air quality in the house.

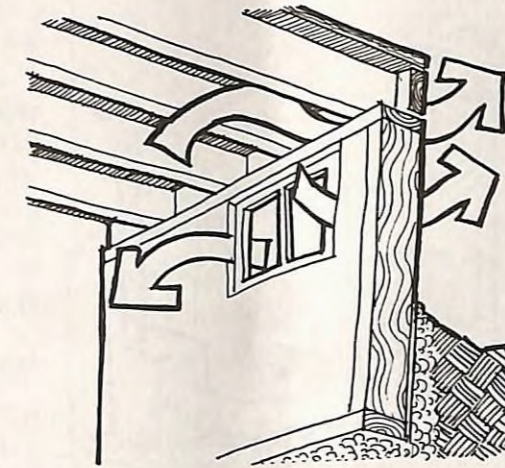
On the other hand, leakage through the foundation can be a major problem as radon gas and many other soil gases can be brought into the house. In winter the basement is usually at a slightly negative pressure so the pressure difference across the foundation walls and floor could drive the soil gases into the house, which are a cause of indoor air quality problems.

What about air quality concerns specifically related to preserved wood foundations (PWF)? A major advantage of preserved wood foundations over traditional concrete foundations is the inherent flexibility of the materials, so it should not suffer from the shrinkage crack problems of concrete foundations. However, some preserved wood foundation systems have relied on poorly installed membranes in the floor area that may not have reasonable service lives.

A study sponsored by CMHC tested the air leakage of preserved wood foundations and the amount of "off-gassing" from the chemicals used for wood preservation in PWF basements in fourteen houses.

Soil gases enter basements through cracks and holes in the air barrier and are affected by various driving forces.

If properly built, there is no reason why preserved wood foundations should present a problem in the area of air leakage, but there are many details used in wood foundations that may not contribute to the long-term integrity of the air barrier.



A test method to measure air leakage below grade had to be developed. When the basement was depressurized no flows through below-grade areas were detected. The test method couldn't be used to determine the level of below grade air infiltration because the most of the air leakage was found to be around windows and headers, factors not related with the PWF system.

The basement wall cavity was sampled and the air analyzed for volatile organic compounds. Chemicals encountered were

compared to those used in the wood preserving process. All concentrations found were very low and well under the Ontario Ministry of the Environment ambient air quality criteria.

To determine likely below-grade air infiltration paths, samples of wall cavity air, basement air and air from below sleeper floors were taken and analyzed for radon levels. The only places where detectable flows were found were at headers, around plumbing stacks and around windows. No detectable flows were found in the PWF walls.

"Airtightness and Air Quality in Preserved Wood Foundations" by Buchan, Lawton, Parent Limited for Canada Mortgage and Housing Corporation National Office; 700 Montreal Road Ottawa, ON K1A 0P7

Letter to the Editor

Sir,

I have to congratulate you on Solplan Review. I pass it around to the best people! I wish the clean style used to communicate technical information was the general rule in publishing.

I am V.P. of one of Canada's older PVC window companies and have been involved in the area of standards. As a result, when your article on the A-440 window standard (Solplan Review No. 44, April-May 1992) was published I had some comments I want to share with you.

Manufacturers do not submit a sample of 1000mm by 1000mm. Size varies with the type of window submitted.

Water tightness ratings were changed in the M-90 version to go up to B7 (for commercial uses). Window load, as well, goes to C5.

Condensation testing was required for aluminum windows in the M-84, but the M-90 makes it optional for all windows. The greater use

of overall energy rating (ER) systems that incorporate computer simulated testing (such as A440.2) used by Ontario Hydro in their grant program has affected the need for condensation resistance testing. Many metal windows in common use can't compare in efficiency to the newer PVC designs.

You didn't mention the forced entry test which is now part of the National Building Code, even if it is separate from the A440.

Energy ratings are the key element in the future. It is interesting to see how relatively unimportant air infiltration is compared to solar heat gain in the A-440.2. Bulky windows suffer dramatically in an overall energy comparison even if they are marginally tighter.

Once again, thanks for an excellent publication.

Phil Lewin, Vice President
Canadian Thermo Window Industries, Weston Ont.

Combustion Safety for Residential Equipment

Energy conservation, changes in building airtightness, appliance design and building materials, along with fuel switching, have all combined to potentially cause safety problems due to combustion equipment. The main concern is the level of pollutants in the indoor environment. Some of these may cause immediate, even life threatening problems; others longer term chronic health problems.

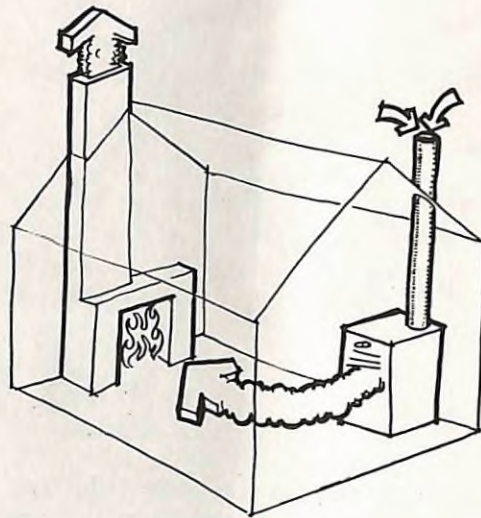
As homes become tighter, combustion equipment has a harder time getting enough air to operate properly. Spillage of incomplete combustion products or even chimney reversals can result in high levels of carbon monoxide and other combustion products being exhausted into the house.

Conventional flues are being called on to handle lower flows, temperatures and different fuels than they were designed for; the results are more condensation, corrosion, draft problems and generally unhealthy appliance performance. In the worst cases failures can result in life-threatening situations.

Combustion equipment requires air for the combustion process itself and for dilution. The dilution device (the draft hood on a gas system or the barometric damper on an oil system) is located downstream of the heat exchanger; it's there to separate the combustion from outside pressure fluctuations, but it needs 2 to 10 times the amount of air needed for combustion.

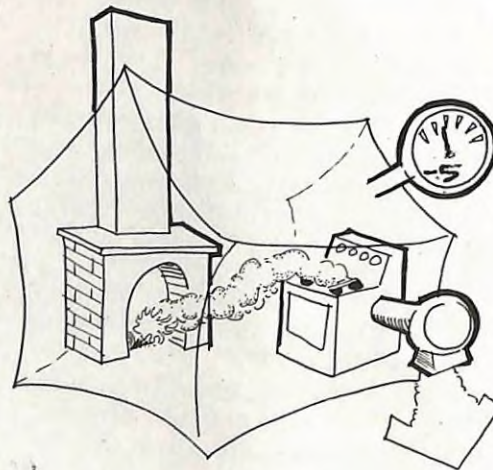
Conventional wood-burning fireplaces require the most air. While new houses may have an air change rate of 1/2 air changes per hour or less, fireplaces need 3 times this amount. The fireplace with a blazing fire, maximum draft and air needs can reverse the flow through the furnace flue; but when the fire is smouldering the reverse can happen, with the furnace pulling the incomplete combustion products from the fireplace into the living space.

New gas or oil-fired equipment eliminate the dilution by forcibly exhausting combustion products, either with a fan or



a series of powerful combustion pulses. These higher efficiency, low air demand appliances are well suited to the low energy homes of today, significantly reducing the chance for combustion spillage into the house.

Some household appliances such as down-draft cooktops have powerful exhaust fans. In a tighter house, or one with marginal draft due to poor chimney construction or maintenance they can cause combustion equipment to spill combustion gases into the house.



The only way to avoid this type of problem is to provide each with its own air supply.

Even the clothes dryer exhaust could create pressure imbalances high enough to cause problems. One way to overcome this is to duct outside air directly to the dryer. (At cold winter temperatures, the moisture content of the incoming air will be very low and should actually aid the drying process).

What Pollutants affect indoor air quality air?

Carbon Monoxide

Carbon Monoxide (CO) is a colourless, odourless, tasteless gas produced in any combustion process when there is incomplete combustion. High concentrations can quickly be fatal. Improving the combustion lowers the amount of CO produced.

On oil and gas furnaces, the poorest combustion is usually at start-up, where draft is marginal and mixing between fuel and air is not fully established. This can result in peaks of CO as much as ten times the "good tune".

Hydrocarbons

Hydrocarbons are generated during the instant of start-up or shut-down. If CO is dealt with, so are hydrocarbons.

Nitrogen Oxides

Nitrogen Oxides (NO_x) is a colourless, tasteless gas formed during combustion. NO₂ reduces the body's ability to absorb and distribute oxygen and can stress the cardiovascular system. It is one of the prime contributors to low level ozone and urban smog.

The hotter the flame and/or the more nitrogen in the fuel, the more NO₂ is formed. Modification of the flame pattern or mixing can reduce NO_x. Typical oil and gas furnaces produce about 80 ppm NO_x during average conditions. Some advanced combustion technologies are capable of producing NO_x levels 7 times lower.

HOT 2000 WHAT IS IT?

HOT2000 is an advanced approach to the design and modelling of energy efficient structures.

HOT2000 is an easy-to-use computer program designed to assist builders, architects and engineers design low-rise residential buildings. Utilizing current heat loss/gain and system performance models, the program aids in the simulation and design of buildings for thermaleffectiveness, passive solar heating and cooling systems (cooling calculations version 6.0 only).

WHAT CAN IT DO FOR ME?

HOT2000 lets you input comprehensive data on proposed building design, analyze the expected heat loss/gain, and revise and test altered designs until a satisfactory design is achieved.

Contains extensive weather data, several models for HRV, foundation, water heating systems and more.

HOW TO GET HOT 2000

HOT2000 is available from the Canadian Home Builder's Association (CHBA) in either a Canadian or USA version at the following prices:

- * \$120.00 (Cdn) for v. 5.06 Canadian version
- * \$150.00 (US) for v. 5.06 for the USA version (US weather data)
- * \$225.00 (Cdn) for v. 6.0 Canadian version
- * \$275.00 (US) for v. 6.0 US version (US weather data)

Price includes User and reference manuals

To order HOT 2000, complete the attached form and send it with a cheque or money order to:



HOT 2000 Sales
CHBA, Suite 200
150 Laurier Ave. West
Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060

ORDER FORM

Please send me:

- _____ copies HOT2000 v5.06 (Cdn version) @ \$120
- _____ copies HOT2000 v5.06 (US version) @ US\$150
- _____ copies HOT2000 v6.0 (Cdn version) @ \$225
- _____ copies HOT2000 v6.0 (US version) @ US\$275

Please indicate hardware type:

IBM Mac 5.25" disk 3.5" disk
Canadian orders add 7% GST

My cheque money order in the amount of \$_____ is enclosed. Make cheques payable to Canadian Home Builder's Assoc.

Name _____

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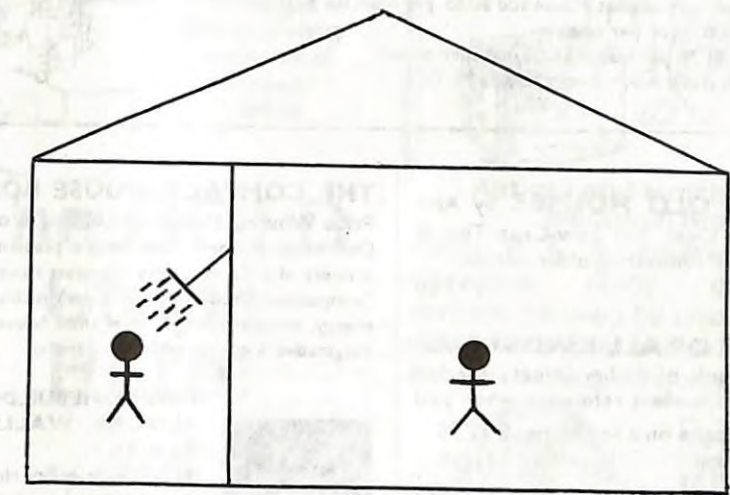
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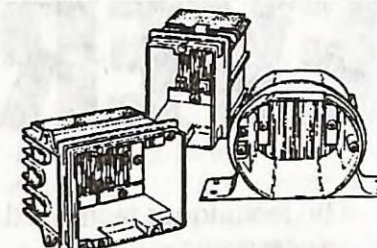
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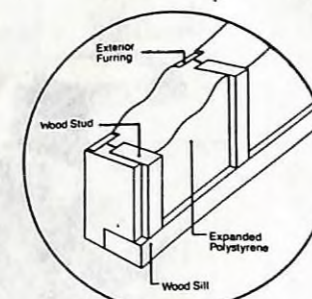
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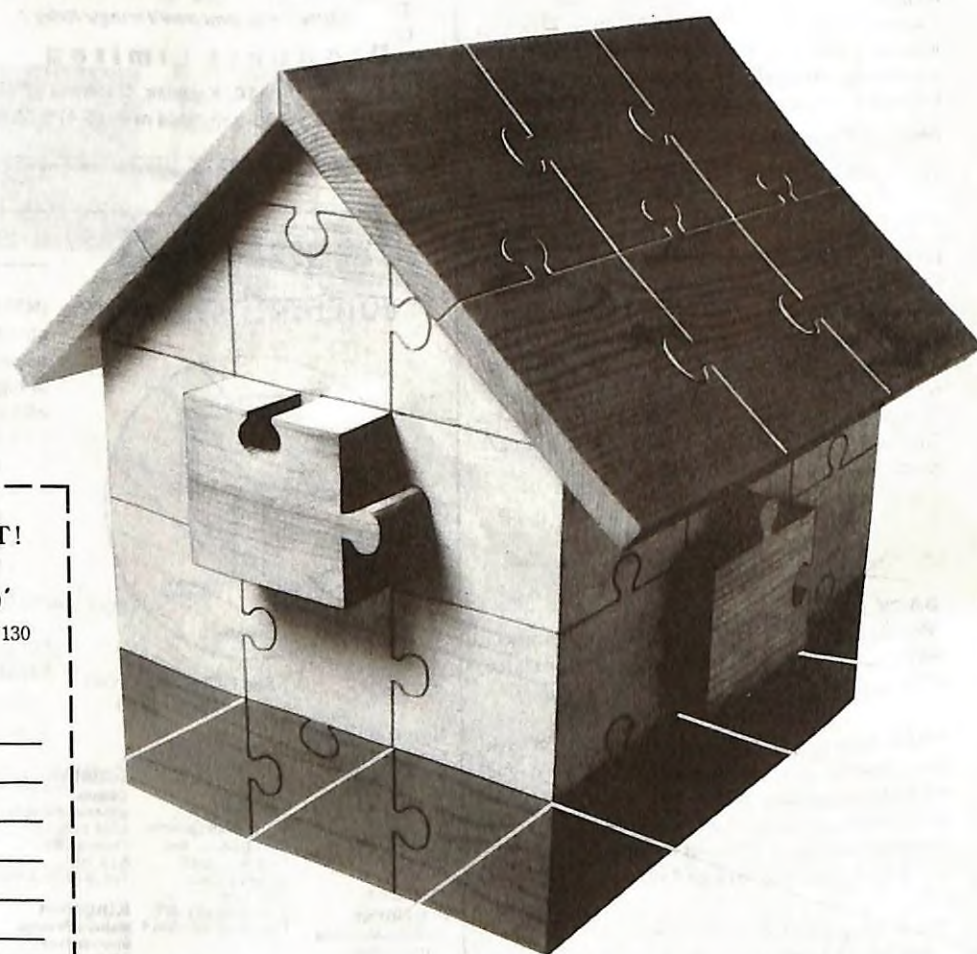
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Particulates and Polycyclic Organic Matter

Particulates and polycyclic organic matter are small pieces of solid matter that are incomplete combustion products usually produced during smouldering combustion, such as in cigarette smoke, fireplaces or damped-down wood stoves.

Sidestream smoke (smouldering cigarettes) can be more harmful because of the increased level of pollutants produced due to the even poor combustion.

Running wood stoves at high firing rates give better burning. Long slow overnight burns, using new, advanced technology stoves with properly vented combustion products to the outdoors should ensure minimal release of these pollutants inside the house.

Appliance Air Requirements

Over a typical Canadian heating season, a furnace will be on for only 15% to 25% of the time, depending on the degree of furnace oversize, but to calculate how much air is needed the unit must be treated as if it is on continuously.

Table 1 shows the air requirements of various combustion equipment for a typical Canadian house.

Gas Systems

Most conventional gas furnaces have naturally aspirating atmospheric burners, with no fan or blower to assist either in the fuel-air mixing, generation of flue drafts or exhausting the combustion products. A continuously-open draft hood has a large dilution air requirement.

In a tighter house or if the chimneys is unsuitable, conventional gas furnaces can be subject to spillage of flue gasses, especially if other equipment with large air demands such as a fireplace are also operating. If the combustion is disrupted, incomplete combustion products, such as carbon monoxide, may be released into the indoor environment.

New higher efficiency gas furnaces/boilers and small, advanced combustion, clean burning wood stoves have no significant air demand and are ideal for lower energy consuming, tighter houses of to-

day. They offer safer operation, making any spillage of combustion products unlikely, as well as improving the performance efficiency as well.

Wood Combustion Appliances

Fireplaces:

Fireplaces are very inefficient, supplying little, if any, energy to the house but they have massive air requirements. At high burning rates a typical fireplace may need 24,000 cu. ft./hr (680 m³/h) of air. Fireplaces should be recognized as a major source of pollutants to the indoor environment.

The best way to ensure that fireplaces don't create problems is not to use one. If they are to be used, they should be isolated from the house with tight fitting glass doors and their own air supply. Artificial firelogs can lower the air needed, reduce emissions by 50-80% and significantly lessen the chances of combustion gas spillage into the house.

Airtight Wood Stoves

Wood can be used efficiently in a well-designed airtight wood stove. These can have an efficiency of up to 50-70%. Air requirements for such a stove are low: only about 600 cu. ft./hr (17 m³/h). There is no dilution of flue gases need on an airtight wood stove; new designs are cleaner

burning, producing 80% less pollutants, with even less potential to cause indoor air quality problems.

Unvented Kerosene Heaters

These appliances have been marketed widely; they may offer comfort and efficiency only if used carefully. Having no vent, they exhaust the combustion products into the living space so there is reason for concern if they are used for extended periods of time.

There may be long term health problems due to nitrogen oxides, particulates, carbon monoxide and even sulphur dioxide if the fuel is not good quality.

The air demand of an unvented kerosene heater is about 141 cu. ft./hr (4 m³/h).

Gas-Fired Ranges

An appliance similar to the unvented heater is the gas range. Concern has been expressed about incomplete combustion products such as CO, as well as normal by-products of combustion, particularly nitrogen oxides (NO_x) venting into the house.

The range hood fan exhausted directly to the outside should be run continuously when the range is being used to ensure that all combustion products are removed from the living space. The energy penalty is slight (except, perhaps in the harshest of arctic climates).

Table 1: Air Demands for Residential Combustion Equipment

Appliance	Combustion Air	Dilution air	Total
Conventional Oil	2295 cu.ft./hr (65 m³/hr)	6885 cu.ft./hr (195 m³/hr)	9180 cu.ft./hr (260 m³/hr)
High Efficiency Oil	1307 cu.ft./hr (37 m³/hr)		1307 cu.ft./hr (37 m³/hr)
Conventional Gas	1801 cu.ft./hr (51 m³/hr)	5049 cu.ft./hr (143 m³/hr)	6850 cu.ft./hr (194 m³/hr)
Induced draft gas	1553 cu.ft./hr (44 m³/hr)		1553 cu.ft./hr (44 m³/hr)
Condensing Gas	1024 cu.ft./hr (29 m³/hr)		1024 cu.ft./hr (29 m³/hr)
Fireplace	24010 cu.ft./hr (680 m³/hr)		24010 cu.ft./hr (680 m³/hr)
Airtight Wood Stove	600 cu.ft./hr (17 m³/hr)		600 cu.ft./hr (17 m³/hr)

Poor Performance Due to Chimney Problems

Venting problems are increased by the fact that many masonry chimneys were not well built originally. These can include: lack of tile liner; incomplete tile liner; misaligned or cracked tiles; non-continuous connection of the flue pipe and chimney liner; defective chimney cap; changing fuel from oil to gas (gas has twice the moisture content in the flue gas, a higher dewpoint and lower flue gas temperatures. This promotes increased condensation and corrosion in the vent).

Simple indications of deterioration in masonry chimneys include deterioration of the exposed tile at the top of the chimney; cracking of the chimney cap; efflorescence (whitening) on the outside of the brick; spalling of the brick and mortar; tile segments at cleanout door; yellowish staining on the outside of the chimney; staining as evidence of water run-out at chimney clean-out door; staining or corrosion of the flue pipe connecting the appliance to the chimney.

Prefabricated metal chimneys are not immune to problems, so must be installed and maintained correctly.

Chimneys should be examined and defective chimneys repaired or relined whenever a combustion appliance is modified, changed or added to the system, to ensure good draft and proper combustion performance.

Chimney Location

In Canada most masonry flues are on the outside wall with three sides exposed to the cold air. The house often works better as a chimney than the flue itself, so that creating a draft is difficult. Chimneys should *always* be located inside the heated envelope.

Flue drafts are influenced by height, temperature and wind. It is often thought that the major factor affecting draft is height so if there is a problem nearly everyone will say, "increase the height of your chimney." However, this is not the case; proper design and location are the answer.

From "Combustion Safety For Residential Appliances" presented at the Affordable Comfort VI conference, Pittsburgh, March 1992 by A.C.S. Hayden; Combustion & Carbonization Research Laboratory (CCRL); ERL/CANMET Energy, Mines & Resources Canada. Ottawa, Canada K1A 0G1



The "Open" House

Canada Mortgage and Housing Corporation (CMHC) has designed an "Open" House, a barrier-free display house to promote accommodations suitable to a wide range of occupants. It was designed and assembled with advice from leading experts in the barrier-free design field and from people with disabilities.

Design and products take into account users' needs in four main areas: mobility disabilities, sight impairments, hearing limitations and environmental sensitivities.

The needs of individual persons vary greatly, depending upon the type and extent of their disability. The "Open" house does not advocate any one particular design or product but illustrates a number of possibilities for safer, more independent living. There are a number of common design elements. While they address special issues at the same time they can make any house pleasant and liveable.

Safety and accessibility are primary considerations for all aspects of the "Open" House. Some of the features of the house that make it more accessible are high lighted here. These include:

Wider hallways and doorways for easier movement of furniture and wheelchairs throughout the house. Swing clear door hinges on all doors.

Fresh air and natural lighting to every room of the house and an outdoor deck and garden.

Materials that reduce indoor air pollution. These include low vinyl content tile flooring with a transparent liquid beeswax finish that emits no harmful vapours, and an odourless, non-toxic, water-based adhesive for all floor finishes.

Light switches and electrical outlets that are at consistent locations and at heights accessible to everyone.

The entry

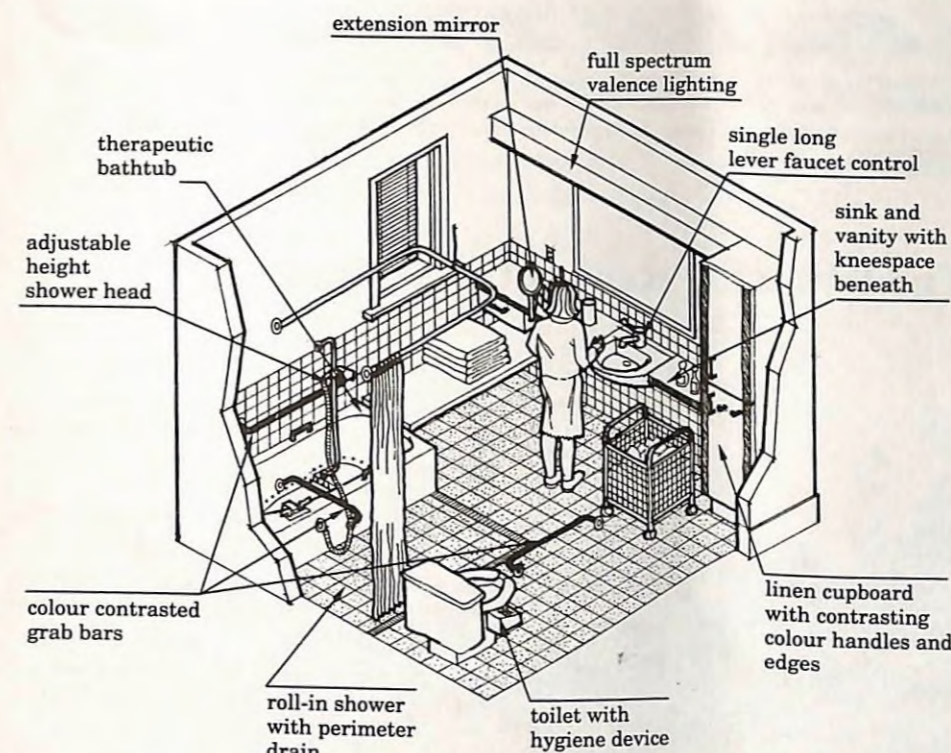
Features include: level floor area at the entrance covered by a large overhang; a bench by the doorway to set packages on while opening door; wide angle peep holes at both standing and sitting eye levels; seating while putting on boots, etc. A two door entry vestibule for better indoor climate control.

Child's Bedroom

Ease of access and the ability to care for a child are important in a child's bedroom, which is located on the ground floor. Features include colour contrasting to assist people with visual impairments distinguish between counter and wall edges; wheelchair accessible crib; desk lamp which has a touch activated base; closet organizer that provides height adjustments for clothes rods and shelves; window with a low sill height that allows a small child to see outside; carpet made of 100% unbleached cotton which does not release any harmful emissions.

The Bathroom

Safety and independence are two important objectives in the bathroom: reinforcement is built into the walls so grab bars may be easily added where and when required according to an individual's personal needs; the toilet incorporates a personal hygiene device with a heated seat



that uses a warm-water spray and air dryer, eliminating the need for toilet paper; the roll-in shower with perimeter drain is large enough to accommodate a wheelchair and also acts as a transfer area; the deep bathtub includes jets positioned to massage the back and legs and includes built-in grab bars; knee space under the shallow sink and vanity makes it possible for wheelchair users to get in close; the vanity mirror is large enough to be seen from any height. An interesting innovation is that the entire bathroom is designed as a "wet" area for safer and more functional use of the room.

Living Room

The living room contains an environmental control system that allows residents to operate the television, video cassette recorder, blinds, windows and lights from a single location; motorized window controls and casement windows with large handles to make it easier to open and close windows; metal venetian blinds which collect less dust than fabric draperies and emit less gaseous fumes, while providing occupants with natural light and privacy control; a strobe light activated by a smoke detector to alert hearing-impaired residents to the possibility of fire; a wheel-

chair lift in the stair case providing access to other floors.

The Kitchen

Designed to provide all amenities within easy reach from both a standing and seated position. Features include side opening oven door with a pull-out board beneath; lowered cooktop and counter for use from a seated position; a rangehood tucked under the upper cabinet so that sharp corners do not protrude into the room; a shallow sink with knee space beneath for use when seated, the goose-neck faucet is operated by a single long lever; automatic dishwasher with a minimum number of push button controls of contrasting colours; electrical outlets provided on the side edge of the counters for easier access.

Laundry Room

The design considerations in the laundry room include: open space under the counters to make it easy to sort or fold clothes while seated; adjustable height fold-down ironing board; front-loading washing machine and dryer with front-mounted controls which are large and easy to use; a laundry tub equipped with a single-lever faucet control within easy reach at the side.

Mechanical System

The mechanical system is designed to provide a comfortable healthy indoor environment. It includes a heat recovery ventilator (HRV); air purification through filters set up on the cold side of the heating coil; and electric boiler with a copper heating coil which provides steady relatively low temperature heat to the forced air heating system. Electricity was selected to avoid any potential combustion fumes and gas spillage into the house - a consideration for some hyper sensitive people. (Alternatives could include a heat pump system, or gas fired units located outside the heated envelope of the house).

The outdoor garden space is designed as a natural extension of the indoor living area: the back door access to the house is through the laundry room; garbage bin on wheels for easy transfer to curbside; raised planters of various sizes and heights for convenient use by adults, children and persons in wheelchairs; bevelled planter design to eliminate sharp corners and obstructions.

The CMHC "Open" House is touring across Canada throughout 1992. For information on the tour, the house design, or the products and suppliers involved, call CMHC "Open" House Hotline (toll-free) 1-800-361-2532.

CMHC has a series of Publications and Videos on Housing for People with Disabilities. Alternate formats include braille, audiotape and large print. For more information: Open House, Project Division, CMHC, 700 Montreal Road, Ottawa, Ontario K1A 0P7

CMHC is sponsoring a symposium entitled "Independence Through Housing" October 1-2, 1992 in Winnipeg. You are invited to attend and learn about some of the latest Canadian innovations aimed at helping people with disabilities live independently. For a program and registration form, call CMHC at 613-748-2249 (Fax: 613-748-2402).

EMR/CANMET NEWS

The Canada Centre for Mineral and Energy Technology (CANMET) is the research and development arm of Energy, Mines and Resources. EMR/CANMET's Buildings Group works with industry to develop and commercialize the technologies to make Canadian houses more energy efficient. With the support of the Buildings Group, Solplan Review presents this information on some current CANMET projects. For more information contact: Energy Efficiency Division, EMR/CANMET, 580 Booth St., Ottawa, K1A 0E4.

Advanced House Objectives: Getting the Word to the Wise

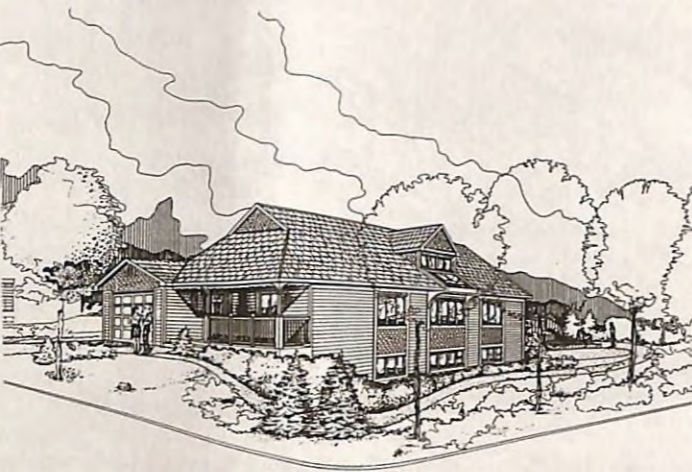
The main goals of the Advanced Houses program is to test new construction concepts, technologies and products. The primary objective is to get information on those technologies and techniques - and how they work - into the hands of those who will continue to use them: builders, architects and designers. Representatives from CANMET's Buildings Group met May 26-27 with all of the Advanced House program and promotions managers to develop options to help meet that objective.

The two day meeting, chaired by the ETA Group, resulted in the drafting of a promotional and technology transfer strategy. The draft details a variety of ways to inform the building community how to integrate environmental responsibility into mainstream housing projects and provide access to the knowledge and skills required in the design and construction of environmentally responsive housing. Some of the approaches include:

- * a nationally distributed brochure detailing all eleven Advanced Houses;
- * a series of factsheets detailing innovative technologies used by the Advanced Houses, such as integrated mechanical, active and passive solar applications and home automation systems;
- * a training package for builders focusing on concepts and technologies adopted by the Advanced Houses project;
- * showcasing the Advanced Houses at the CHBA national convention in February 1993 and at other international conferences scheduled for next year.

EMR is reviewing the draft strategy to develop the final plan. A call for proposals to implement the activities will be issued by mid-July. A fact sheet which provides a one page summary of each project is already available from CANMET's Technology Marketing Division.

The Waterloo Region Green Home



+17 for fixed units. By comparison an R-20 wall would have an ER rating of -6.

Combination Gas Furnace/HRV

The Home is heated by a prototype combination natural gas furnace/heat recovery ventilator. The system uses a mid-efficiency furnace and provides high efficiency (85%) at a relatively low

cost. The HRV is a regenerative rock bed that recovers heat from ventilation exhaust air and hot furnace gases. The HRV is split into two beds that operate independently; one heats incoming air while the other removes heat from the exhaust stream. When one bed is heated and the other cooled, the airflows through the beds are reversed. Using the HRV to capture furnace heat means that acids in the condensate are handled by the rock bed. As a result, the furnace does not require an expensive stainless steel heat exchanger.

Engineered Foundation Panels

The foundation is a factory manufactured system that uses less than one-half the concrete required by standard poured in place foundations, but is engineered to provide the same strength. The system uses 18"x18" pier footings every eight feet. Exterior insulation and sub-slab insulation meet to form an almost continuous blanket around the foundation, significantly reducing thermal bridging. 8 feet high, 16 feet long, 2 inch thick panels are shipped to the site in sections and erected in a few hours.

Windows

Triple glazed, two low-e coatings, argon filled in a fibreglass frame with foam insulation - the windows will actually provide a heat gain. Operable units have an energy rating (ER) of +8 (that is, they gain 8 watts of solar heat, per square metre over the course of the heating season) and

CFC-Free Air Conditioning

Technical requirements do not allow use of appliances, such as air conditioners, that use CFC's. Passive design features such as window overhangs and a light coloured metal roof limit the need for mechanical cooling. As a result the small cooling load of the house can be met through an innovative use of cistern water. When cooling is required, cistern water is run through a coil where it cools recirculated air. The cooling coil is attached to a special slide located in the supply duct. The slide allows the coil to be removed during the heating season in order to reduce the amount of motor power needed to move heating air through the system.

Report on the Advanced Houses Program

We continue our update on the Advanced Houses Program with a look at three more winning submissions. Each of the Advanced Houses had to meet the same set of technical requirements, including environmental targets and an energy performance target (set at one-half that of an R-2000 house). The requirements demanded that the teams find and/or develop innovative materials and mechanical equipment to solve problems and inefficiencies associated with conventionally constructed houses. Each of the teams arrived at their own unique solutions.

The B.C. Advanced House

The B.C. Advanced House is a two-storey, 2800 square foot home (on crawl space) located in Surrey, B. C. From the crushed recycled glass and rock foundation drainage system to the tiles on the roof, the designers have stressed the use of 'environmentally responsible' products.



New Materials

The B.C. house will feature prototype applications of a chemically-inert, waterproof, durable, cement-type product (Contumax™). The product uses a non-portland cement and low-grade cellulose fibres, such as sawdust and shredded newspapers, as aggregate. It is light, easy to work with, and has a low-embodied energy. Different formulations allow the material to be used in a variety of applications. The B.C. House will use it for floor tiles, roof tiles, and plywood for below-grade cladding. Using this material the wood foundation can be built with white wood as opposed to chemically laced preserved wood.

Stressed-Skin Panels

Walls will be constructed with prefabricated, factory assembled, stressed-skin panels. Prefabricated systems have a number of advantages: reduced waste and quality-control at the manufacturing stage and speed of erection on the construction site. In addition, the thinness of the panels allows the installation of high insulating values without taking away from interior house space. Panel insulation will be a

non-CFC polyurethane foam.

The panels for the B.C. House will be brought to a reasonable degree of finish at the factory. Windows and conduits for services will be in place, and some interior finishing work will be complete.

Windows

The B.C. House has a large glass area by design. The architecture reflects a West Coast sense of style but also serves to highlight recent changes in window technology. Multipane, multi low-e, gas filled units show that super-insulated houses don't have to put strict limits on glass area.

Water Temperature Sensor

Water temperature sensors located at each tap maintain a constant flow and preset temperature of water regardless of fluctuations in the hot and cold water supplies. The sensors provide a measure of safety (water isn't allowed to get hot enough to scald), as well as a degree of energy-efficiency.

Home Automation System

The B.C. House will feature the Consumer Electronic Bus (CEBus) home automation system. Like Smart House technology, the CEBus links all household mechanicals, appliances, entertainment and security systems. Unlike Smart House, CEBus does not require specialized communications cable, but can be operated using any number of wiring and wireless systems, including phone lines and infrared controllers. The system monitors and manages electrical use to provide optimum end-use efficiency. As a result, the B.C. House will require only a 60 amp electrical service.

Home automation systems provide an advanced degree of safety and security, from turning a coffee pot off, to lighting the porch when the doorbell rings.

Integrated Heating, Ventilation and DHW System

The House will have an integrated heating system which combines heating, ventilation and domestic hot water systems, in order to maximize the benefits of passive solar gains, provide continuous ventilation and to optimize the efficiency of each system.

The Nova Scotia Envirohome



maximize solar gain. North and east facing windows utilize double Heat Mirror™ films with low-e coatings to minimize heat loss.

Innovative Oil Heating

An innovative oil heating system will meet the remaining space heating demands - innovative because the oil fired boiler operates on the

demands of a 60 gallon storage tank, not on the demands of the house. Oil systems in energy-efficient houses can be inefficient because the low heating loads result in a high number of on-off cycles. The large heat sink provided by the thermal storage tank solves this problem and increases the seasonal operating efficiency because the number of on-off cycles is reduced. The firing period is long enough (15-20 minutes) to allow the boiler to reach its steady-state efficiency of 85% during each on-cycle.

Passive Solar Design

The team estimates that 28% of space heating needs will be met by passive solar energy. The number of windows on the south face was increased and glazings selected based on window orientation. South facing windows are double glazed with hard coat low-e and argon filled to

Two fan coil units draw heat from the storage tank and distribute it to the house - one unit serves the basement and main floor (zone 1); the other unit serves the second floor (zone 2). Heat is provided to each zone separately, and at a level consistent with zone demand.

Demand Control Ventilation

Ventilation requirements will be met by a demand control system that is triggered by carbon dioxide (CO₂) and relative humidity (RH) levels. Two fan coil units deliver fresh air to the basement and main floor (zone 1) and the second floor (zone 2). The HRV itself runs continuously, at a moderate speed. When CO₂ or RH rise above a pre-set limit, fresh air is increased to the zone where levels have been exceeded. The system, which cuts down on fresh air delivery during unoccupied periods, can reduce energy consumption by at least 8% compared to a fixed volume system.

The HRV is powered by a brushless DC electric motor that reduces the motor energy needs by about 50%.

Solar Hot Water

50% of domestic hot water needs are met by a solar water heater with a photovoltaic powered DC circulation pump. The system includes a 60 gallon pre-heat tank. Back-up DHW needs are provided by the boiler.



Canadian
Home Builders'
Association

Code Changes coming

Several changes being proposed to the National Building Code could have important impact on builders.

Drywall standards: A change to drop the minimum density requirement of drywall has been made to the CSA stand-

Technical Research Committee News

ard that applies to its manufacture. Other that type X board, density will no longer be published. This will not affect the strength of a given board, but it will mean that fire and sound ratings will be affected, as the performance depends on the density of the board.

For single family dwellings this will have only have a modest impact, but for multiple family construction or anywhere that fire ratings of assemblies are an issue, the impact will be more severe. It may mean that in some situations 5/8" board

will be needed instead of 1/2".

Because of the changes, reference to the CSA standard may be dropped from the National Building Code.

Drywall discoloration

We've reported on this issue in the past few issues. The complete report is available from the TRC now for those who need to get more information on this.

Truss design changes

It's not widely recognized that roof trusses used in the housing industry are designed much lighter than those used in commercial buildings, because they don't fully meet CSA 086 (the standard that covers truss design and is referred to in Part 4 of the Code). It seems the situation has a historical basis, in that trusses at first had to compete with site cut framing, so there were advantages to having a provision in the code that allowed trusses to be lighter than CSA 086.

Up to now the design of trusses has been handled by the manufacturer's structural engineers, and there have been no problems. The change is not needed based on performance. However, building officials are now looking more and more to have everything covered by some standard, and questions are being raised why trusses don't meet CSA 086. In other words, they want to have it easy to enforce the code. As a result, there is move to make it a code requirement.

This change will mean that trusses will be about 1/3 heavier than current trusses because they use heavier wood members (e.g. 2x6 where 2x4 was accepted before), and 20-25% more expensive.

Truss manufacturers, code staff and CHBA all agree that lighter trusses are not a problem, and will be looking at ways to resolve the issue, so that the heavier construction is not made a necessity. How this issue is going to be resolved is still up in the air.

CHBA Ventilation position paper

The Position paper outlines the basics of what and why of mechanical ventilation. It has now been approved and is an official CHBA position paper. Copies have been distributed to all local Home Builders Associations. Copies are also available from TRC.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector. To contact the TRC:
Canadian Home Builders Association,
150 Laurier Ave. West Suite 200
Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax (613) 232-8214:

You Asked Us:

Does the use of shades, blinds, draperies, etc. increase the energy efficiency of windows? If so, by how much (for each of the 3)?

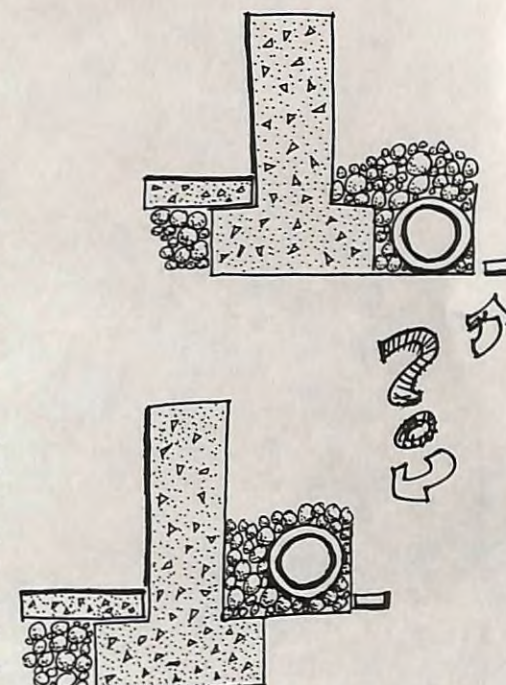
The use of blinds and other window coverings as insulation is often raised. Unfortunately, most window coverings, regardless of type, do nothing for the energy efficiency of windows.

Blinds control the amount of light entering through the window. Depending on the colour, material type (metal is more reflective than fabric) and position of the blind, they can reflect some energy back out the window. However, a significant portion of light energy that has been transmitted through the window undergoes a change in wavelength, as it strikes objects inside and heats them up, whether it be the blind itself, the floor, ceiling or anything in the room so that longer wavelengths (with less energy) are reflected back out, but glass is not very transparent to the longer wavelengths (which is how the greenhouse effect works). If low emissivity glass is used, then even less energy is transmitted out, so more heat is kept inside, which is what you want most of the year (but not in the summer).

Draperies and fabric blinds (especially heavy materials with lining) in theory have a good potential for acting as insulation. However, these types of coverings have to have an airtight seal around the drapery or blind to provide the insulating value, otherwise convection currents are established around the fabric creating air flows around the covering thus eliminating any potential benefits. Airtight seals for window blinds require special consideration if other problems, such as thermal shock to the glass in winter is to be avoided.

Window coverings, especially heavier fabrics, can improve the thermal comfort in a room by reducing the radiant cooling effect felt by an individual. As the fabric surface inside is at a warmer temperature, our body feels more comfortable than if it were facing a large cold surface (like the

window on a cold winter night). So while the body may feel more comfortable, it does not do anything direct for the energy conservation (other than, perhaps, allowing you to set a slightly cooler temperature in the room).



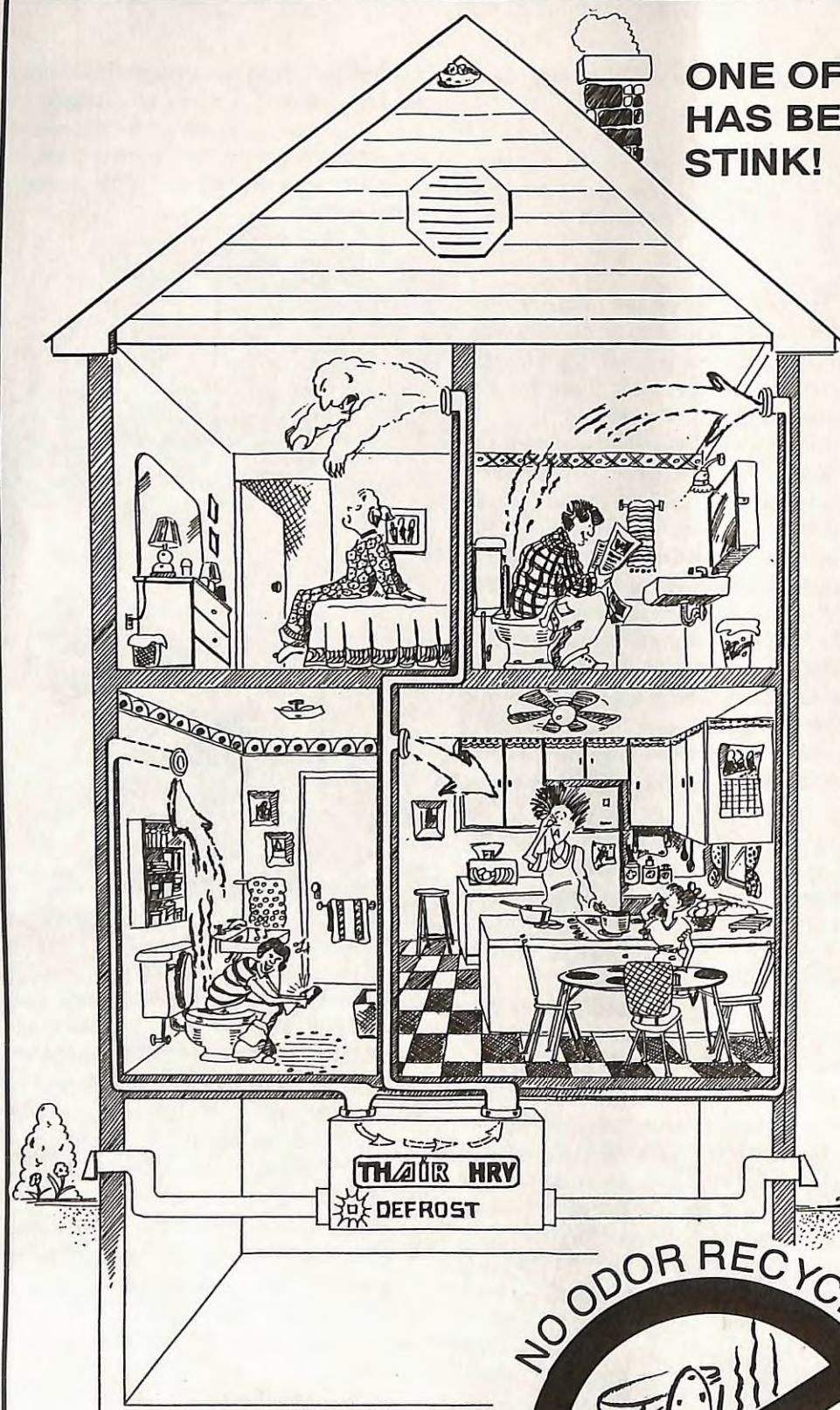
Is it better building practice for weeping tile to be placed at the basement footing level rather than just below slab level?

We must remember that the objective of site drainage is to remove ground water away from the structure before it can do damage. In the case of weeping tile we are trying to remove water that may be coming from the surface, the roof or ground water. A proper system in effect lowers the water table around the house.

Thus when setting the drain tile, the level should be as low as possible. This is why the tile should always at the lowest level possible, below the floor slab level, at the base of the footing, rather than at the slab level.

In the case of preserved wood foundations, the entire basement structure is placed on a crushed rock pad which can accommodate large quantities of water as well as providing an excellent drainage channel to remove water (assuming of course that a sewer, or dry well is available to take the water).

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NUTECH ENERGY SYSTEMS INC.
511 McCormick Blvd.
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Ph 519-457-1904
Fax 519-457-1676